Case Report

Endovascular Treatment of a Traumatic Carotid-Jugular Fistula by Using Stent-Graft

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Traumatic arteriovenous fistulas following carotid artery injuries are rare. Treatment of carotid artery-to-jugular vein fistula requires direct closure of the fistula or occlusion of the carotid artery above and below the level of the fistula, by a surgical or endovascular approach. A 32-year-old man presented with right-sided pulsatile neck swelling and left-sided limb weakness 2 days following a stab wound. Neck computed tomography demonstrated a vascular mass protruding the anterior neck. Digital subtraction arteriography demonstrated a bilobular large internal carotid artery pseudoaneurysm just distal to its bifurcation. There was simultaneous opacification of a dilated left internal jugular vein indicating a high-flow internal carotid-internal jugular fistula. A balloon-expandable stent-graft was delivered and successfully positioned across the fistula. The arteriovenous fistula and pseudoaneurysm were completely disappeared and the right internal carotid artery was preserved well. The stent-graft is a promising technology to obliterate the fistula and preserve the parent artery with relative safety.

KEY WORDS : Arteriovenous fistula · Therapeutic embolization · Carotid artery injury.

Introduction

Traumatic arteriovenous fistulas(AVFs) of the head and neck region are rare, accounting for less than 4% of complications following arterial trauma in this region[11]. Penetrating trauma is the most common cause[13]. Treatment of carotid artery-to-jugular vein (CJ) fistulas requires direct closure of the fistula or occlusion of the carotid artery above and below the level of the fistula, by a surgical or endovascular approach[9,14]. Embolization by detachable balloons, coils or other agents has been used[2,3,7,12]. Preservation of the parent arterial patency and sealing the fistula orifice is considered to be the optimum treatment.

We treated a post-traumatic CJ fistula with a stent-graft to close the fistula orifice and preserve the blood flow of the carotid artery.

Case Report

A 32-year-old man presented with a pulsatile neck swelling 2 days following a stab wound on the neck. Upon admission, the patient's blood pressure was 96/60mmHg and clinical findings included nausea, fainting, and general weakness. Physical examination revealed a 5cm large pulsatile swelling with an audible bruit over the left midcervical region. Neurologic examination disclosed impaired consciousness and the left side weakness(upper limb; grade I, lower limb; grade IV). Neck computed tomography(CT) demonstrated a vascular mass protruding the anterior neck, which was connected with fistulous tract from the internal carotid artery(ICA)(Fig. 1).

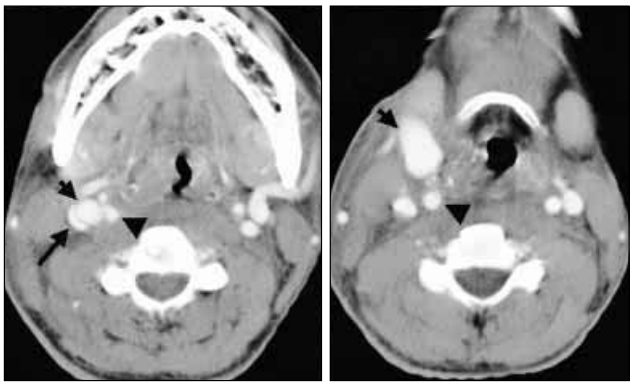

Fig. 1. Neck computed tomographic scans showing a vascular mass (short arrow) protruding the anterior neck, which is connected with fistulous tract from the internal carotid artery (arrowhead). The internal jugular vein (long arrow) is compressed by the vascular mass.

Brain magnetic resonance(MR) imaging revealed a diffuse infarction involving the lower division of the middle cerebral artery territory(Fig. 2). Right common carotid arteriography

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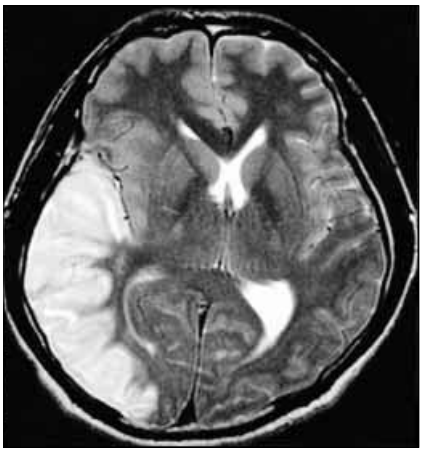

Fig. 2. T2-weighted magnetic resonance image reveals a diffuse infarction involving the lower division of the middle cerebral artery territory.

demonstrated a bilobular large ICA pseudoaneurysm just distal to its bifurcation. There was imultaneous opacification of a dilated left internal jugular vein indicating a high-flow CJ fistula (Fig. 3).

Endovascular graft stenting of the fistula was indicated to obliterate the fistula as well as the pseudoaneurysm and was attempted under local anesthesia. Informed consent for using stent-graft was obtai-ned from the patient and her family.

The stent-graft device (JOST-ENT, JOMED, Helsingborg, Sweden) consisted of a thin-walled expandable polytetrafluoroethylene(PTFE) placed between two flexible stainless steel stents. Under systemic heparinization(5000U intravenously), a 7-F guiding catheter was positioned in the left common carotid artery. A 6~12 $\times$38mm peripheral graft stent was mounted across the fistula on a 6 $\times$ 40mm ultra-thin diamond balloon(Medi-tech, Boston Scientific Corp, watertown, MA) through a 0.035-inch guide wire(Terumo Corp, Tokyo, Japan) (Fig. 4A). Stent was deployed by inflating the balloon to 8 atm with optimal angiographic results(Fig. 4B). The fistula was immediately closed. The postdeployment angiogram demonstrated complete resolution of the pseudoaneurysm and restoration of the normal luminal diameter of the ICA(Fig. 4C).

There was no untoward neurologic deficit at the end of the procedure which lasted for 50min. The neck thrill disappeared immediately after the procedure. Postoperative anticoagulation was continued for 2 days. Oral antiplatelet therapy with 100mg aspirin and 75mg clopidogrel was initiated on the day after the procedure and continued for 1 month.

A follow-up study performed 1 week later demonstrated normal anterograde blood flow through the left ICA (Fig. 5). The patient's neurologic condition has slowly improved, with nearly normal leg strength within 1 week and with useful arm strength at 2 months after treatment.

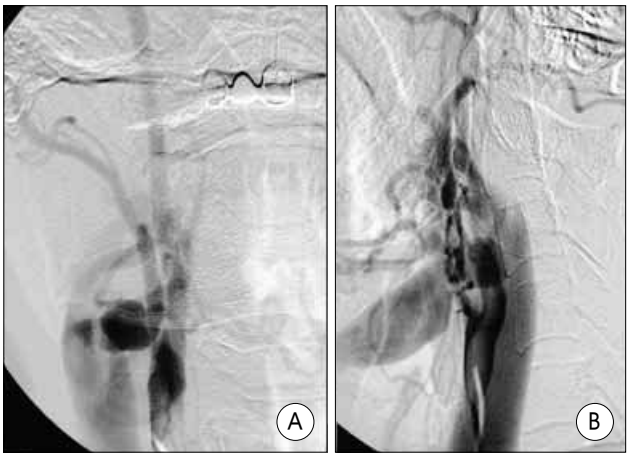

Fig. 3. Right common carotid angiograms, anteroposterior(A) and lateral(B) views demonstrate a bilobular large internal carotid artery pseudoaneurysm just distal to its bifurcation. There is simultaneous opacification of a dilated left internal jugular vein indicating a high-flow internal carotid artery-internal jugular vein fistula.

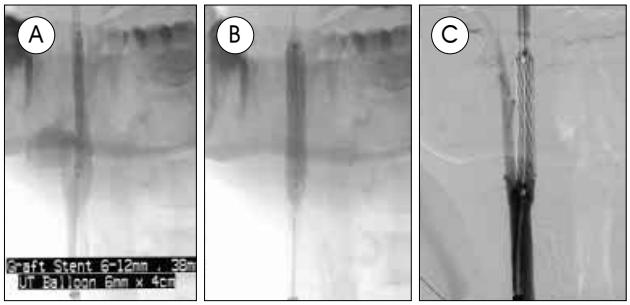

Fig. 4. Magnified unsubtracted view(A) shows a 6~12(38-mm peripheral graft stent (JOSTENT, JOMED, Helsingborg, Sweden) is mounted across the fistula on a 6(40-mm ultra-thin diamond balloon(Medi-tech, Boston Scientific Corp, watertown, MA) through a 0.035-inch guide wire(Terumo Corp, Tokyo, Japan). Stent is deployed by inflating the balloon to 8 atm with optimal angiographic results(B). The fistula is immediately closed. The postdeployment angiogram demonstrates complete resolution of the pseudoaneurysm and restoration of the normal luminal diameter to the vessel(C).

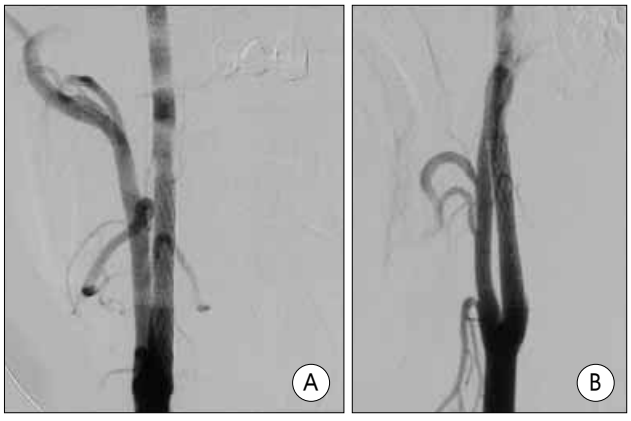

Fig. 5. Follow-up angiograms of the right common carotid artery, anteroposterior(A) and lateral(B) views demonstrate normal antero-grade blood flow through the left internal carotid artery and no evidence of the fistula.

Discussion

AVFs of the neck may result from various causes. The majority is due to complications of gunshot or stab wounds[16]. Occasionally, blunt trauma to the neck, with or without bony facture, may be the etiologic factor. Both military and civilian experiences suggest that slightly more than 5% of patients with penetrating arterial injuries will have AVFs by the time of initial examination[18]. Penetrating wounds or localized contusions involving the carotid arteries can lead to two important late sequelae: AVFs and pseudoaneurysm. In traumatic AVFs, when the arterial wall is punctured, extravasation of blood into a compartment in continuity with the arterial lumen may occur and a false aneurysm is formed. If an artery and an adjacent vein are lacerated simultaneously, the resulting pseudoaneurysmal sac will communicate with both vessels, forming an AVF.

If such injuries are not diagnosed and treated accurately, a chronic AVF may develop. Usually, the diagnosis of AVF of the neck is made easily. Patients with AVF of the neck often complain of a noise synchronous with the arterial pulse. Auscultation discloses a continuous murmur with systolic accentuation. A thrill is also felt over the same area. Patients with carotid artery fistula may have a decrease in the pulse rate when compression is applied on the carotid vessel(positive Branham's test). These patients may also complain of headaches, fainting, visual and hearing disturbances, and hemiparesis. Cardiac decompensation may occur in AVF depending upon the size of the artery involved, its situation to the arch of the aorta, the size of the fistula, and its duration. The involved vessels cannot usually be identified before angiography. The most logical approach is to start with digital subtraction angiogram which will reveal the fistula.

The goal is to occlude the fistula while preserving the parent artery[4]. CJ fistulas should be treated by excision of the fistula, with vascular wall reconstruction. Either lateral arteriorrhaphy or end-to-end anastomosis is carried out[6,10,16]. If the defect that remains after excision is too large for primary repair, a graft is used. Although endovascular treatment with detachable balloons has been advocated due to its being more safe and less traumatic by some authors[2,5], it has been suggested by the others that it should be considered for suitable fistulae at the cranial base, either pre- or perioperatively as an adjunct to surgery, or as the sole treatment in patients with cardiac decompensation to avoid the risks of general anesthesia and an operative procedure[3,13,18]. In this case, we thought the use of a detachable balloon was discarded, because of the large orifice of the shunt. We also discarded using Guglielmi detachable coils, because of the high flow and the poor thrombogenicity of the coils[7].

Vascular stenting in the treatment of dissection or atherosclerotic disease of the cerebral circulation is growing in popularity. Covered stents have been used elsewhere in the circulation with good angiographic and clinical results[17,19]. Recently, silicone-covered stents have been attempted in closing all experimentally created CJ fistula[4]. These stents eventually became encased in fibrocellular tissue without significant narrowing of the vessel lumen. The stent-grafts used in our case were balloon-expandable and the most commonly used custom-made stent-grafts. The balloon-expandable stent-graft can be closely fitted in the vessel by using several balloons of different diameters. PTFE is a useful material for covering the stent for several reasons. The material has long-term compatibility and thromboresistance, and can be expanded with an angioplasty balloon and yet maintain adequate strength. Good patency and no graft expansion has been reported in the observation period[1,8,15].

Conclusions

We describe a case in which graft stent was deployed for CJ fistula occlusion. Graft stent constructs can achieve AVF occlusion with relative safety and may provide an alternative therapeutic method for preserving the parent artery and obliterating the fistula. Improvement of the device is still needed, but the stent-graft is a promising technology to treat neurovascular AVFs.

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